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(56) Documents Cited

GB 2250789 A

GB 2198195 A

GB 2191825 A

WO 93/03299 A

SU 001539331 A

US 5318309 A

US 5181728 A

US 5074748 A

(58) Field of Search

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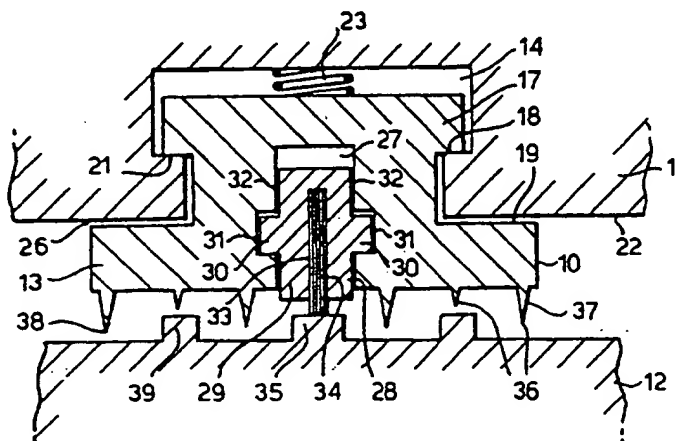
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ON LINE DATABASES:WPI,CLAIMS

(54) Shaft seal arrangement

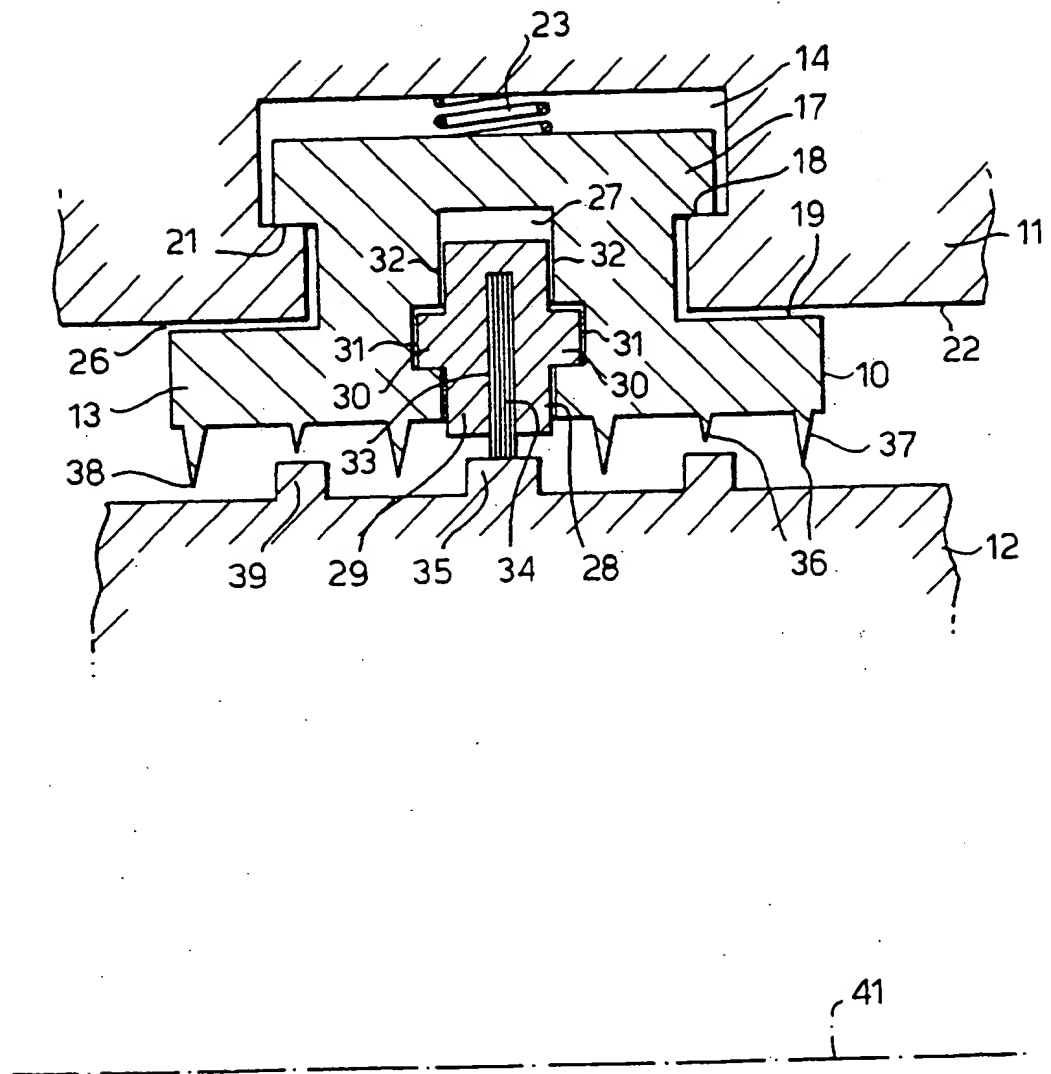
(57) A seal arrangement 10 acting between a stationary component 11 and a rotatable component 12 of a turbine comprises a brush seal 34 and a fin seal 36 mounted on a common floating carrier member 29.

Fig.1.



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Fig.1.



SHAFT SEAL ARRANGEMENT

This invention relates to a shaft seal arrangement particularly but not exclusively for use
5 in a turbine, between the shaft and the stationary part embracing the shaft, to prevent the
working fluid bypassing the blade flow path. It should be understood that the term "shaft" is
intended to include any flange, cylinder or like formation incorporated in the shaft.

The efficiency of a turbine is significantly affected by leakage of the working fluid
10 between stationary and rotating parts; the fluid is thereby unable to do useful work in the turbine
blading.

The invention seeks to provide a seal arrangement having good efficiency and long life
particularly in the high pressure environment of a turbine.

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According to one aspect of the invention there is provided a shaft seal arrangement
comprising a brush seal and a fin seal mounted on a common floating carrier member.

In a preferred arrangement the carrier member is mounted loosely in a stationary part and
20 is spring biased radially towards the shaft.

The fin seal may be a separate component fixed to the carrier member or may be formed
integrally with the carrier member. In the former case each fin seal may be provided by a strip
of material caulked into a respective slot in the carrier member.

A plurality of fin seals may be provided each having different radial extents to confront corresponding shaft diameters in a staggered formation so as to act to provide a labyrinthine leakage path.

5 In a preferred arrangement the brush seal is mounted in a brush seal assembly which in turn is mounted in an annular recess in the carrier member.

The carrier member may comprise a plurality of segmental sections juxtaposed so as to form an annulus, the segmental sections being carried in an annular keyway in said stationary
10 part. It is further preferred that each segmental section carries a section of the brush seal and a section of the fin seal and is individually spring biased towards the shaft.

According to another aspect the insertion provides an assembly comprising a rotary shaft, a stationary part and a shaft seal arrangement as defined above acting between the stationary part
15 and the shaft; the stationary part and rotary shaft may be parts of a turbine.

In a preferred arrangement electrical insulating means is provided to prevent flow of electricity through the brush seal between the movable and the stationary parts; the insulating means may be provided at least partly by a coating of non-conductive material on the brush seal
20 and/or at least partly by coating the movable part with non-conductive material.

The invention will be further explained, by way of example, with reference to the accompanying drawing the single Figure of which illustrates a seal arrangement for use in a turbine.

In the figure a seal arrangement 10 is shown as acting between a stationary component 11 and a rotatable component 12 of the turbine to prevent gas leakage between components 11, 12. In the turbine embodiment being described, the component 12 takes the form of a shaft rotatable within component 11 which is of generally annular form, the axis 41 of the shaft being shown in its correct orientation but not necessarily in its actual position. More especially, for ease of assembly and as described subsequently, the component 11 is preferably of segmented form.

The seal arrangement 10 comprises a main carrier member 13 of annular form embracing the shaft 12. The carrier member 13 has a uniform cross-section including a key or hammer-head formation 17 which engages a corresponding circumferential keyway 14 in the component 11 thus trapping the body member in position.

The body member 13 floats, i.e. is a loose fit in the keyway 14, permitting limited radial movement. A spring 23 between the component 11 and the body member 13 biases the body member radially inwards towards the shaft this movement being limited by abutment between the hammer-head surface 18 and a shoulder 21 in the wall of the keyway 14.

The carrier member in fact comprises a series of segments extending around the keyway, which may have an exit section (not shown) through which the segments can be inserted and removed.

In the arrangement referred to above where the component 11 is also of segmented form, the segments of the carrier member 13 are inserted prior to assembly of component 11, and in

this case there is no exit section.

In the normal rest position of carrier member 13 there is a clearance 26 between a shoulder 19 of carrier member 13 and a stop surface 22 on component 11. This clearance 26 allows of radial movement of the main carrier member 13, such radial movement being accompanied by sliding movement between adjacent segmental parts of the carrier member. The arrangement will also allow of a degree of tilting of the carrier member 13.

The main carrier member 13 itself is provided with a recess 27 shaped as shown and adapted to receive a brush seal assembly 28. The assembly 28 of part-annular or annular form depending on the construction of carrier member 13 comprises a member 29 formed with lugs 30. Lugs 30 are received with clearance in slots 31 in the side walls 32 of recess 27. The clearance allows a degree of radial movement of the assembly 28.

Mounted within a slot 33 in the carrier member 29 is a brush seal 34, the brush seal 34 being held in slot 33 by appropriate fastening means (not shown). In the usual arrangement the carrier member 29 is in two halves; the two halves are welded together and the weld simultaneously acts as fastening means to hold the brush seal in assembly. Such fastening means may alternatively comprise one or more spring clips, a clamp arrangement or an adhesive appropriate to the particular environment. A secondary locking arrangement may be associated with the primary fastening means to ensure security of assembly.

The brush seal 34 comprises a pack of inclined bristles filling the gap between shaft 12 and member 29 and arranged to rub against the shaft 12.

The brush seal 34 provides the primary seal in this arrangement and transient deviation of shaft 12 from its normal running position is absorbed by bending of the bristles. As shown the bristles actually engage a locally raised platform 35 on the shaft 12. This will nullify any effects of wear on shaft 12, and prevents local heating leading to axial stresses which could bend the shaft 12.

The seal arrangement also involves a secondary sealing feature. This is provided by one or preferably a plurality of fin seals 36 extending circumferentially around the inner face of the main body member 13. They may be machined so as to be integral therewith or they may be provided by caulking in the body member strips of material into appropriate slots. The fin seals thus provided have generally triangular cross-sections 37. As shown these cross-sections terminate in points 38, which points are adapted to just clear the surface of the shaft 12, although it will often be appropriate for the sections 37 to terminate in a flat section rather than a point. As shown, one or more of the fin seals 36 may confront respective local platforms 39 on the shaft 12.

The fin seals produce a pressure drop to thereby provide an impedance to leakage. It is envisaged that the fin seals may have different radial extents and confront corresponding shaft diameters in a staggered formation thus providing a labyrinthine leakage path; alternatively the fin seals will all have the same diameter to confront a shaft of uniform diameter.

In a preferred arrangement it is arranged that no electric current should pass between the parts 11, 12 through the brush seal since current might cause local heating or other deleterious effects. This may be achieved by e.g. giving the shaft-engaging portion of the brush seal 34 a

coating of non-conductive material or additionally or alternatively by applying such a coating to the shaft platform 35.

CLAIMS

1. A shaft seal arrangement comprising a brush seal and a fin seal mounted on a common
5 floating carrier member.
2. A shaft seal arrangement as claimed in Claim 1 wherein the carrier member is mounted
loosely in a stationary part and is spring biased radially towards the shaft.
- 10 3. A shaft seal arrangement as claimed in Claim 1 or Claim 2, wherein the fin seal is a
separate component fixed to the carrier member.
4. A shaft seal arrangement as claimed in Claim 1 or Claim 2 the fin seal is formed
integrally with the carrier member.
- 15 5. A shaft seal arrangement as claimed in Claim 3 wherein each fin seal is provided by a
strip of material caulked into a respective slot in the carrier member.
6. A shaft seal arrangement as claimed in any preceding claim wherein a plurality of fin
20 seals have different radial extents and confront corresponding shaft diameters in a
staggered formation so as to act to provide a labyrinthine leakage path.
7. A shaft seal arrangement according to any preceding claim, wherein said brush seal is
mounted in a brush seal assembly which in turn is mounted in an annular recess in said

carrier member.

8. A shaft seal arrangement as claimed in any preceding claim wherein the carrier member comprises a plurality of segmental sections juxtaposed so as to form an annulus.

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9. A shaft seal arrangement as claimed in Claim 8, wherein said segmental sections are carried in an annular keyway in said stationary part.

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10. A shaft seal arrangement as claimed in Claim 8 or Claim 9, wherein each said segmental section carries a section of said brush seal and a section of the fin seal and is individually spring biased towards the shaft.

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11. An assembly comprising a rotary shaft, a stationary part and a shaft seal arrangement as claimed in any preceding claim acting between the stationary part and the shaft.

12. An assembly as claimed in Claim 11 wherein the stationary part and rotary shaft are parts of a turbine.

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13. An arrangement as claimed in any of Claims 1-10 or an assembly as claimed in Claim 11 or Claim 12 wherein electrical insulating means is provided to prevent flow of electricity through the brush seal between the movable and stationary parts.

14. An arrangement or assembly as claimed in Claim 13 wherein said insulating means is provided at least partly by a coating of non-conductive material on the brush seal.

15. An arrangement as claimed in Claim 13 or 14 wherein said insulating means is provided at least partly by coating the movable part with non-conductive material.

- 5 16. A shaft seal arrangement substantially as hereinbefore described with reference to the accompanying drawing.

17. An assembly comprising a movable part and a stationary part and a shaft seal arrangement substantially as hereinbefore described with reference to the accompanying drawing.
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Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

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(ii) Int Cl (Ed.6) F16J 15/00

Search Examiner
 A R MARTIN

Date of completion of Search
 7 JUNE 1995

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-
 ALL CLAIMS

(ii) ONLINE DATABASES: WPI, CLAIMS

Categories of documents

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| <p>X: Document indicating lack of novelty or of inventive step.</p> <p>Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.</p> <p>A: Document indicating technological background and/or state of the art.</p> | <p>P: Document published on or after the declared priority date but before the filing date of the present application.</p> <p>E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.</p> <p>&: Member of the same patent family; corresponding document.</p> |
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Category	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2250789 A (ROLLS ROYCE) see Figure 2	Claim 1 at least
Y	GB 2198195 A (ROLLS ROYCE) see Figure 1	Claims 1 at least
Y	GB 2191825 A (ROLLS ROYCE) see Figure 2	Claim 1 at least
Y	US 5318309 (GEC) see Figure 3	Claim 1 at least
Y	US 5181728 (GEC) see Figure 5C	Claim 1 at least
X,Y	US 5074748 (GEC) see Claim 1	Claim 1 at least
Y	WO 93/03299 (CROSS) see Figure 1	Claim 1 at least
Y	SU 1539331 (KHARK) see Figure 1	Claim 1 at least